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REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 1.29

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SEISMIC DESIGN CLASSIFICATION

A. INTRODUCTION

General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena," of Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10, Part 50, of the *Code of Federal Regulations* (10 CFR Part 50), "Domestic Licensing of Production and Utilization Facilities" (Ref. 1), requires that nuclear power plant structures, systems, and components (SSCs) important to safety must be designed to withstand the effects of earthquakes without loss of capability to perform their safety functions.

Toward that end, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 establishes quality assurance requirements for the design, construction, and operation of nuclear power plant SSCs that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public. The pertinent requirements of Appendix B apply to all activities affecting the safety-related functions of those SSCs.

In addition, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," to 10 CFR Part 50, requires that all nuclear power plants must be designed so that certain SSCs remain functional if the safe-shutdown earthquake ground motion (SSE) occurs.[1] These plant features are those necessary to ensure (1) the integrity of the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in a safe shutdown condition, or (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guideline exposures of 10 CFR 50.34(a)(1) or 10 CFR 100.11.[2]

This guide describes a method that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for use in identifying and classifying those features of light-water-reactor (LWR) nuclear power plants that must be designed to withstand the effects of the SSE.

This regulatory guide relates to information collections that are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 100, which the Office of Management and Budget (OMB) approved under OMB control numbers 3150-0011 and 3150-0093, respectively. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

After reviewing a number of applications for construction permits and operating licenses for boiling- and pressurized-water nuclear power plants, the NRC staff developed a seismic design classification system for identifying those plant features that must be designed to withstand the effects of the SSE. In so doing, the staff designated as Seismic Category I those SSCs that must be designed to remain functional if the SSE occurs.

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1 Appendix S to 10 CFR Part 50 applies to applicants for a design certification or combined license pursuant to 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," or a construction permit or operating license pursuant to 10 CFR Part 50 on or after January 10, 1997. However, the earthquake engineering criteria in Section VI of Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100, "Reactor Site Criteria" (Ref. 2), continue to apply to operating license applicants or holders whose construction permit was issued before January 10, 1997.

2 Dose values set forth in 10 CFR Part 100, "Reactor Site Criteria" (Ref. 2), continue to apply to operating license applicants or holders whose construction permits were issued before January 10, 1997. However, application of 10 CFR 50.67, "Accident source term," with the alternative source terms identified in the latest edition of Regulatory Guide 1.183,"Alternative Radiological Source Terms for Evaluating Design-Basis Accidents at Nuclear Power Reactors" (Ref. 3), is a voluntary option to meet the new positions in this regulatory guidance.

C. REGULATORY POSITION

1. The following SSCs of a nuclear power plant, including their foundations and supports, are designated as Seismic Category I and must be designed to withstand the effects of the SSE and remain functional. The titles and functions of these Seismic Category I SSCs for LWR designs are based on existing technology from prior applications. Certain SSCs previously considered Seismic Category I may no longer have a safety-related function requiring Seismic Category I classification, and certain passive SSCs in new LWR designs may be titled differently. The pertinent quality assurance requirements of Appendix B to 10 CFR Part 50 shall apply to all activities affecting the safety-related functions of these SSCs:

   a. the reactor coolant pressure boundary

   b. the reactor core and reactor vessel internals

   c. systems[3] or portions thereof that are required for (1) emergency core cooling, (2) post-accident containment heat removal, or (3) post-accident containment atmosphere cleanup (e.g., hydrogen removal system)

   d. systems[2] or portions thereof that are required for (1) reactor shutdown, (2) residual heat removal, or (3) cooling the spent fuel storage pool

   e. those portions of the steam systems of boiling-water reactors extending from the outermost containment isolation valve up to but ***not*** including the turbine stop valve, and connected piping of a nominal size of 6.35 cm (2.5 inches) or larger, up to and including the first valve that is either normally closed or capable of automatic closure during all modes of normal reactor operation (the turbine stop valve should be designed to withstand the SSE and maintain its integrity)

   f. those portions of the steam and feedwater systems of pressurized-water reactors extending from and including the secondary side of steam generators up to and including the outermost containment isolation valves, and connected piping of a nominal size of 6.35 cm (2.5 inches) or larger, up to and including the first valve (including a safety or relief valve) that is either normally closed or capable of automatic closure during all modes of normal reactor operation

   g. cooling water, component cooling, and auxiliary feedwater systems[2] or portions thereof, including the intake structures, that are required for (1) emergency core cooling, (2) post-accident containment heat removal, (3) post-accident containment atmosphere cleanup, (4) residual heat removal from the reactor, or (5) spent fuel storage pool cooling

   h. cooling water and seal water systems[2] or portions thereof that are required for functioning of reactor coolant system components important to safety, such as reactor coolant pumps

   i. systems[2] or portions thereof that are required to supply fuel for emergency equipment

   j. all electrical and mechanical devices and circuitry between the process and the input terminals of the actuator systems involved in generating signals that initiate protective action

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[3] The system boundary includes those portions of the system required to accomplish the specified safety function and connected piping up to and including the first valve (including a safety or relief valve) that is either normally closed or capable of automatic closure when the safety function is required.

k. systems[2] or portions thereof that are required for (1) monitoring and (2) actuating systems[4] important to safety

l. the spent fuel storage pool structure, including the fuel racks

m. the reactivity control systems (e.g., control rods, control rod drives, and boron injection system)

n. the control room, including its associated equipment and all equipment needed to maintain the control room within safe habitability limits for personnel and safe environmental limits for vital equipment

o. primary and secondary reactor containment

p. systems,[2] other than radioactive waste management systems,[5] not covered by items 1.a through 1.o above that contain or may contain radioactive material and of which postulated failure would result in conservatively calculated potential offsite doses [using meteorology as recommended in the latest editions of Regulatory Guide 1.3, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling-Water Reactors” (Ref. 6), Regulatory Guide 1.4, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Pressurized Water Reactors” (Ref. 7), and Regulatory Guide 1.183, “Alternative Radiological Source Terms for Evaluating Design-Basis Accidents at Nuclear Power Reactors” (Ref. 3)] that are more than 0.005 Sievert (0.5 rem) to the whole body or its equivalent to any part of the body or total effective dose equivalent (TEDE), as applicable

q. the Class 1E electrical systems, including the auxiliary systems for the onsite electric power supplies, that provide the emergency electric power needed for functioning of plant features included in items 1.a through 1.p above

2. Those portions of SSCs of which continued function is not required but of which failure could reduce the functioning of any plant feature included in items 1.a through 1.q above to an unacceptable safety level or could result in incapacitating injury to occupants of the control room should be designed and constructed so that the SSE would not cause such failure.[6]

3. At the interface between Seismic Category I and non-Seismic Category I SSCs, the Seismic Category I dynamic analysis requirements should be extended to either the first anchor point in the non-seismic system or a sufficient distance into the non-Seismic Category I system so that the Seismic Category I analysis remains valid.

4. The pertinent quality assurance requirements of Appendix B to 10 CFR Part 50 should be applied to all activities affecting the safety-related functions of those portions of SSCs covered under Regulatory Positions 2 and 3 above.

5. Regulatory Guide 1.189, “Fire Protection for Operating Nuclear Power Plants” (Ref. 8), provides guidance used to establish the design requirements for portions of fire protection SSCs to meet the requirements of GDC 2, as they relate to designing those SSCs to withstand the effects of the SSE.

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[4] See the latest edition of Regulatory Guide 1.151, “Instrument Sensing Lines” (Ref. 4).

[5] See the latest edition of Regulatory Guide 1.143, “Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants” (Ref. 5).

[6] Wherever practical, structures and equipment of which failure could possibly cause such injuries should be relocated or separated to the extent required to eliminate that possibility.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this regulatory guide. No backfitting is intended or approved in connection with its issuance.

Except in those cases in which an applicant or licensee proposes or has previously established an acceptable alternative method for complying with specified portions of the NRC's regulations, the NRC staff will use the methods described in this guide to evaluate (1) submittals in connection with applications for construction permits, standard plant design certifications, operating licenses, early site permits, and combined licenses, and (2) submittals from operating reactor licensees who voluntarily propose to initiate system modifications if there is a clear nexus between the proposed modifications and the subject for which guidance is provided herein.

REGULATORY ANALYSIS / BACKFIT ANALYSIS

The regulatory analysis and backfit analysis for this regulatory guide are available in Draft Regulatory Guide DG-1156, "Seismic Design Classification" (Ref. 9). The NRC issued DG-1156 in October 2006 to solicit public comment on the draft of this Revision 4 of Regulatory Guide 1.29.

REFERENCES

1. *U.S. Code of Federal Regulations*, Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," U.S. Nuclear Regulatory Commission, Washington, DC.[7]

2. *U.S. Code of Federal Regulations*, Title 10, Part 100, , "Reactor Site Criteria," U.S. Nuclear Regulatory Commission, Washington, DC.[7]

3. Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design-Basis Accidents at Nuclear Power Reactors," U.S. Nuclear Regulatory Commission, Washington, DC.[8]

4. Regulatory Guide 1.51, "Instrument Sensing Lines," U.S. Nuclear Regulatory Commission, Washington, DC.[8]

5. Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.[8]

6. Regulatory Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling-Water Reactors," U.S. Nuclear Regulatory Commission, Washington, DC.[8]

7. Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Pressurized Water Reactors," U.S. Nuclear Regulatory Commission, Washington, DC.[8]

8. Regulatory Guide 1.189, "Fire Protection for Operating Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.[8]

9. Draft Regulatory Guide DG-1156, "Seismic Design Classification," U.S. Nuclear Regulatory Commission, Washington, DC, October 2006.[9]

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[7] All NRC regulations listed herein are available electronically through the Electronic Reading Room on the NRC's public Web site, at http://www.nrc.gov/reading-rm/doc-collections/cfr. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email PDR@nrc.gov.

[8] All regulatory guides listed herein were published by the U.S. Nuclear Regulatory Commission or its predecessor, the U.S. Atomic Energy Commission. Most are available electronically through the Electronic Reading Room on the NRC's public Web site, at http://www.nrc.gov/reading-rm/doc-collections/reg-guides/. Single copies of regulatory guides may also be obtained free of charge by writing the Reproduction and Distribution Services Section, ADM, USNRC, Washington, DC 20555-0001, by fax to (301) 415-2289, or by email to DISTRIBUTION@nrc.gov. Active guides may also be purchased from the National Technical Information Service (NTIS). Details may be obtained by contacting NTIS at 5285 Port Royal Road, Springfield, Virginia 22161, online at http://www.ntis.gov, by telephone at (800) 553-NTIS (6847) or (703) 605-6000, or by fax to (703) 605-6900. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room (PDR), which is located at 11555 Rockville Pike, Rockville, Maryland; the PDR's mailing address is USNRC PDR, Washington, DC 20555-0001. The PDR can also be reached by telephone at (301) 415-4737 or (800) 397-4209, by fax at (301) 415-3548, and by email to PDR@nrc.gov.

[9] Draft Regulatory Guide DG-1156 is available electronically under Accession #ML062540294 in the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room (PDR), which is located at 11555 Rockville Pike, Rockville Maryland; the PDR's mailing address is USNRC PDR, Washington, DC 20555-0001. The PDR can also be reached by telephone at (301) 415-4737 or (800) 397-4209 by fax at (301) 415-3548, and by email to PDR@nrc.gov.